Studies on effect of sowing time and fertilizer level on growth, yield and economics of Rajmah (*Phaseolus vulgaris* L.) – Mung Bean (*Vigna radita*) Cropping Sequences.

A synopsis presented to Jharkhand Rai University in the partial fulfilment of the thesis requirement for the degree of Doctor of Philosophy in Agriculture (Agronomy)

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Introduction

India is the largest producer of pulses accounting for about 25 percent of the global share. Pulses are the second most important group of crop after cereals in Jharkhand. During 2017-18 pulse was cultivated in 5.53 lakh ha. with annual production of 4,95,134 tonnes leading average productivity of 881 kg per ha. (Agriculture Directorate, Kharif Work shop Report, 2015-16) Pulses are least preferred by farmers because of high risk and also being less remunerative than cereals Consequently, the production of the pulses is sufficiently low it and doesn't meet the daily requirement of the growing population. The per capita per day availability of pulses has been reduced from 61g in 1951 to 32g in 2000 (DES, 2004) against the minimum requirement of 60g and optimum requirement of 104g per day per capita. Out of different strategies to increase pulses production, the introduction of promising pulse crops such as Rajmah (*Phaseolus vulgaris* L.) to non-traditional areas holds on of the options. Its seed contains 22-25% protein, 11.7% fat and 70% carbohydrates. The green pods contain 1.0-2.4% protein, Rajmah belongs to Leguminosae family have become popular all over the world due to its health benefits as well as their savory texture. It is also known as "red kidney bean", "common bean" & "navy bean". Rajmah is popularly termed as **"King of nutrition"**.

Rajmah is an important cool season legume crop grown for its tender pods, shelled green bean and dry beans. Rajmah has various culinary uses. Various healthy dishes can be prepared using this bean in India. Dry seeds have also medicinal value. The foliage of crop may also used as fodder & green manure purpose.

In India, both bushy and trailing type variety are grown it is a herbaceous annual plant grown worldwide for its edible dry seed (known as just "beans") or unripe fruit (green beans).

Some of the health benefits of Rajmah are as follows. Rajmah may help in preventing cancer, improve brain function, control blood sugar level and prevent diabetes. It also help in bone strength/prevent osteoporosis, preventing bad cholesterol (LDL), maintaining healthy skin, preventing irritable bowel syndrome (IBS), weight loss due to its high fibre content.

Brazil is top producer of Rajmah in the world. Globally, Rajmah is cultivated on about 28.0 m ha. with a production of 19.0 million tons (Anon, 2003). In India important Rajmah growing states are Jammu and Kashmir, Himachal Pradesh, Uttrakhand, West Bengal, Utter Pradesh, Tamil Nadu, Kerala, Karnataka, Punjab, Bihar and Maharashtra covered an area of 98,000 ha with production of 1000 tones. In Jharkhand it is gradually being popular, especially among progressive farmers.

In India, Rajmah is grown in kharif and rabi season in different part. Rajmah has shallow root system causing moisture stress at any crop growth stage which is detrimental to its performance. As a rainy late kharif season crop, it can be grown as rainfed crop like other pulses.

Unlike other pulse, Rajmah is very inefficient to biological nitrogen fixation owing to poor nodulation. One of its poor nitrogen fixing characteristic of Rajma symbiotically the respond of nitrogen application is quite responsive. Due to this, it requires relatively higher doses or nitrogenous fertilizer (100 kg Nha^{-1}). The productivity of Rajmah is low in various state due to inadequate use of fertilizer which is most important reasons of its low productivity.

Being a leguminous crop spacing and nutrient management play an important role for higher yield of Rajmah. Out of the different factor affecting the yield of Rajmah may be increased by sowing Rajmah crop with appropriate combination of planting date and nutrient management.

Statement of problem

Rajmah is one the important pulse crop grown in the country but its area very meagre in Jharkhand. It is highly rich in protein and other nutrition for good health. It eradicate malnutrition among poor farm family. It is used in both form pulses & vegetable.

Keeping in view its nutritive value and yield (about 20 q/ha) and low water requiring characteristic a field experiment is designed for suitable sowing time and nutrient management in Jharkhand plateau.

It is also suitable for double crop to increase the cropping intensity, employment generation among marginal farmers and also good remedy for malnutrition of tribal children. Mokaka et al (2016) suggested about 138.5 Kg N / ha. for Rajmah in middle Gujrat conditions. Majority of the area of Jharkhand is under mono cropped due to rainfed situation how ever by introducing low water requiring pulse crop like Rajmah & Moon bean the scenario may be changed for increasing double crop since very inadequate formation is available for Jharkhand region hence a field experiment is desired.

REVIEW OF LITERATURE

EFFECT OF SOWING DATE

The higher plant height was recorded from 30th October and 15th November sown chickpea crop (71.0 cm and 65.7 cm respectively). Delay in sowing on 30th November and 15th December results in decreased plant height (61.8 cm and 61.7 cm respectively). (Patel *et al*. 1999).

Ahlawat (1996) reported that the French bean crop sown on 15 and 30 October recorded higher number of branches per plant (3.57 and 4.0 respectively) compared with that sown early (1 October with 3.12) and late (15 November 3.31).

At Kinnaur, Saini and Negi (1998) found that the number of branches per plant in French bean varied with time of sowing. The earliest sowing on 15 April being statistically on par with 30 April produced significantly higher number of branches per plant (6.8 and 6.7 respectively) over the remaining date of sowing.

Singh and Singh (2000) found that number of branches significantly higher in rajmash sown on 30th October (15.99) compared to 15th October sown crop (15.34).

Sreelatha et al. (1997) at Baptla on a sandy clay soil was found that LAI was low in the beginning (25DAS) and reached a peak by 40 DAS followed by a sharp decline towards harvest. The LAI values were significantly higher when sowings were done on November 1st over those of delayed sowings. The higher LAI values in early sowing might be due to optimum temperature and sunshine hours resulting in higher photosynthetic surface area. Sreelatha *et al*. (1999)also reported at Baptla found that November 1st sowing of French bean caused a significant increase in number of seeds per pod (2.31) over November 16 (2.08) or December 1st (1.87) sowing. Further, the authors reported that November 1st sowing caused a significant increase in grain yield(565 kg ha^{-1}) compared to November 16 (472 kg ha^{-1}) and December 1st(335 g ha^{-1}) sown crop. They reported that November 1st

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From Bangladesh, Mozumder et al. (2003) found that earlier (15 October) planting of rajmah required maximum time for flowering (48.53 DAP) while late planting (15 December) gave earlier flowering (44.90 DAP). Mazumder et al. (2003) also reported that both the plantings of 15 October (18.46) and 15 November (19.46) produced higher number of pods per plant than 15 December planting (14.79).

Sekhon *et al*. (1992) at Ludhiana found that earlier sowing on 10th September recorded higher number of pods per plant (6.21) which was on par with 17th September sowing (5.23) while it was minimum (3.53) for 1st October sowing.

Ahlawat (1995) found that the French bean crop sown on 15 (3.37) and 30 October (3.43) recorded higher value of seeds per pod compared with that of early sown during 1st October (2.62) and late sown during 15th November (2.52).

Saini and Negi (1998) at Kinnaur reported that the earlier sowing of rajmash on 15 April being on par with 30 April, recorded higher test weight with 1000-seeds (581.47 and 578.3g, respectively) over the remaining dates of sowing. Lower test weight was recorded with 30 May sown crop (402.4g).

Rajesh Kumar *et al*. (1983) at Faizabad revealed that gram varieties sown on 30 October gave higher yield (26.0 q/ha). Delay in sowing beyond 30 October reduced the yield significantly.

Singh and Singh (2000) at Allahabad reported that, the rajmash grain yield was significantly higher (26.43 q ha^{-1}) in 30th October sown crop compared to 15th October (24.49 q ha^{-1}) sown crop.

Among the date of sowing, first fortnight of June recorded significantly higher harvest index value (44.20%) closely followed by second fortnight of June (42.94%), which were on par. The lower harvest index was recorded with second fortnight of July (37.56%). (Mallikarjun, 2004).

November 1st sowing of rajmah recorded higher harvest index (45.2%)over November 16 (43.2%) December 1 (40.2%) sowings.

EFFECT OF NUTRIENT MANAGEMENT

Singh et al. (2003) reported that significantly maximum pods plant^{-1}, pod length, seeds pod^{-1}, 100 seed weight, seed yield, B:C ratio and NPK uptake by grain and straw were recorded when crop was fertilized with 120-90-45 kg NPK ha $^{-1}$.

Thakur et al. (1999) revealed that application of NPK @ 75.0-64.5-62.3 kg ha^{-1} produced significantly higher seed yield.The authors concluded that from the different six rate of NPK, application of 22.5+ 135 + 60 kg N+ P2O5+ K2O ha^{-1} found significant for growth and yield attributes like plant height, plant spread, number of branches, seed and stover yields.

An experiment was carried out at Belvatigi (Karnataka) during *rabi*2003-04 to 2005-06 to study the response of french bean to phosphorus levels. Chaudhary*et al.* (2008) reported that application of phosphorus significantly increases the seed and pod yields.

Sherawat and Singh (2009) reported that plant height, branches plant^{-1}, pods plant^{-1}, pod length, 100 grain weight, grain and straw yields were significantly maximum when crop was fertilized with 180 kg N and 60 kg K2O ha^{-1}.

Singh et al. (2009) revealed significantly maximum plant height, days to 50% flowering, branches plant^{-1}, pods plant^{-1}, pod diameter, pod length, seeds pod^{-1},100 pod weight and green pod yield plant^{-1} plot^{-1} were recorded when french bean was fertilized with 180 kg N ha^{-1}.

Shubhashree et al. (2011*)* revealed that significantly maximum dry matter plant^{-1}, pods plant^{-1}, seeds pod^{-1}, grain weightplant^{-1}, grain yield and NPK uptake were observed when crop was fertilized with 120- 75- 60 kg N -P2O5- K2O ha^{-1}.

Salehin and Rahman (2012) studied the effect of zinc and nitrogen fertilizers and their application method on yield and yield components of rajmah (*Phaseolus vulgaris* L.) at University of Development Alternative, Dhaka (Bangladesh) during 2011. The results showed that the application of nitrogen @ 90 kg ha^{-1} recorded significantly higher seed yield, 100 seed weight, pods plant^{-1}, seeds pod^{-1}, plant height and days for maturity.

Dwivedi et al. (2013) revealed that the application of 100 kg N and 60 kg P_2O_5 ha^{-1} produced significantly taller plant, more pods $plant^{-1}$, seeds pod^{-1}, 1000 seed weight and seed yield as well as higher B:C ratio during both the years in rajmah crop.

Kashinath and Ramakrishna (2015) They found significantly higher pod yield and NPK uptake at different growth stages with the application of 62.5-100-75 kg NPK ha^{-1}.

Lad et al. (2014) reported that higher dose of nitrogen (150 kg N ha^{-1}) and phosphorus (75 kg $P_2O_5ha^{-1}$) produced significantly higher plant height, branches $plant^{-1}$, leaves $plant^{-1}$, dry matter $plant^{-1}$, pods $plant^{-1}$, pod dry weight $plant^{-1}$, seeds $pods^{-1}$, 100 seed weight, seed yield, harvest index, protein content, gross and net return during individual years and in pooled results, while BCR was higher under 100 kg N and 50 kg P_2O_5 ha^{-1}.

Shahid et al. *(*2015) reported that significantly maximum plant height, branches $plant^{-1}$, pod length, pod weight, pod yield and gross and net return were recorded when crop was fertilized with 120 kg N, 90 kg P_2O_5 and 90 kg K_2O ha^{-1}.

Shanka et al. (2015) reported that the application of phosphorus @ 92 kg ha^{-1} recorded significantly higher pods $plant^{-1}$, seed weight, dry biomass yield, pods $plant^{-1}$ and grain yield.

Motaka et al. (2016) reported that economically optimum dose of nitrogen for rajmah was 138.57 kg ha^{-1} under middle Gujarat conditions.

OBJECTIVES OF THE STUDY

1. To study the effect of time of sowing and nutrient management on growth, yield and quality of Rajmah.

2. To study of the effect of Rajmah crop on fertility status and soil health on Rajmah-Mung bean cropping sequences.

3. To study the economics of Rajmah-Mung bean cropping sequences.

4. To prepare information bulletin in local language for farmers / undertake frontline demonstration in farmer's field.

RESEARCH METHODOLOGY

A field experiment will be conducted consequently during 2018-19 and 2019-20 crop seasons. During both year no of treatment of field trial conducted at JHARKHAND RAI UNIVERSITY / Farmer Field with following details.

FIELD EXPERIMENT (Trial-1)

The field experiment comprising of twenty treatment laid out in split plot design with three replications. The details of treatment described are as follows

DETAILS OF THE TREATMENT

Effect of sowing date and fertility level on growth and yield of Rajmah

A) **Main plot treatment :** Sowing time 4 levels.

S_1 - First Fortnight of October

S_2 - Second fortnight of October

S_3 - First fortnight of November

S_4 - Second fortnight of November

B) **Subplot treatment :** Nutrient management levels – 5 levels

F_0 - N_0 P_0 K_0 S_0 kg/ha

F_1 - N_{60} P_{20} K_{40} S_{20} kg/ha

F_2 - N_{80} P_{40} K_{40} S_{20} kg/ha

F_3 - N_{100} P_{60} K_{40} S_{20} kg/ha

F_4 - N_{120} P_{80} K_{40} S_{20} kg/ha

Trial-2 : Moong Bean Crop after harvest of Rajmah

DETAILS OF LAYOUT

The details about layout is given as under:

		Rajmah	Moong Bean
1	Experimental design	Split plot Design	Split plot Design
2	Number of replications	3	3
3	No. of treatment	20	20
4	Total Number of plot	60	60
5	Plot Size –	5.0 × 4.0 m	5.0 × 4.0 m
6	Crop and Varieties	Rajmah, Swarna Priya	Moong Bean,SML 668
7	Seed rate	80 Kg ha -1	30 Kg ha -1

8	Spacing	30 × 10 cm	30 × 10 cm
9	Date of Sowing	As per treatment	After harvest of Rajmah
10	Irrigation	As per need	As per meed
11	Fertilizer dose	As per treatment	Nil

OBSERVATIONS TO BE RECORDED

A) GROWTH PARAMETERS

1. Plant population / m Sq
2. Plant height (cm)
3. No. of Branch / Plant
4. No. of Trifoliate leaf / Branch
5. Leaf Area Index at 20, 40, 60, 80 & 100 DAS
6. Date of flowering
7. Dry matter production at 20, 40, 60, 80 & at 100 DAS

B) YIELD PARAMETERS

1. No. of Pod / plant at harvest
2. No. of Seed / Pod
3. Seed weight / plant (gm)
4. Weight of 100 seed (gm)
5. Grain yield (Q/ha)
6. Haulm Yield (Q/ha)
7. Harvest Index

C) SOIL ANALYSIS

1. Organic Carbon (%)
2. PH
3. Initial and final Soil Status of both the crops
4. NPKS uptake (Kg/ha)

D) QUALITY PARAMETERS

1. Protein content of seed (%)
2. Protein yield (Kh/ha)

E) ECONOMICS

1. Cost of Production (Rs/ha)
2. Gross return (Rs/ha)
3. Net return (Rs/ha)
4. Per day return (Rs/ha)
5. B:C ratio
6. Economics of cropping sequence

- **Data analysis :** The above field trail will be conducted in split plot design date will be analysed statistically.

- **Conclusion :** On the basis of result conclusion will be drawn for the benefit for farmer.

- **Future scope of the research:** To be based on the results obtained.

- **Tentative chapterization :**

1. Introduction
2. Statement of problem
3. Review of literature
4. Research & methodology
5. Conclusion
6. Bibliography

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